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MULTIPLE PEST PROBLEMS AND CONTROL ON TOMATO

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The primary nematode parasites of tomatoes (***Lycopersicon esculentum*** Mill.) in Florida include the root-knot nematodes (***Meloidogyne*** spp.) and the sting nematode (***Belonolaimus longicaudatus*** Rau, 1958), either of which may cause extensive root damage and yield loss (5). Tomato production problems on the sandy soils of Florida often involve complexes of nematodes and plant diseases such as fungal wilts, southern blight and damping-off fungi, bacterial wilt, and soil insects (6). Tomato yield losses are often significantly increased as a result of the interaction between nematodes and other pests (1Ø). In this regard, nematodes can be especially significant in terms of disease development and yield suppression by elevating disease pathogens to major pest status even though their population levels or pathogenic potential are low (1Ø). The most well documented example is the root-knot nematode and wilt disease complex on old tomato production land (5,7,9).

Changes in tomato plant growth and development in response to parasitism by the root-knot nematode have been shown to increase plant susceptibility to ***Verticillium*** and ***Fusarium*** wilt diseases (2,5,1Ø). The root-knot nematode, as its name implies, causes the development of root galls which interfere with plant water and nutrient movement (Fig. 1). Galls also provide a nutrient rich food source which is rapidly colonized by the fungi, thereby increasing wilt development and severity (Fig. 2). Yield losses are subsequently increased over those which would have occurred in the presence of either pest alone (1Ø).

Many factors influence nematode damage and their interaction with other soil borne pests. For example, the fine to coarse textured sands, characteristic of peninsular Florida tomato producing areas, favor the interaction between root-knot nematode and some fungal diseases (1,1Ø). With increasing soil particle size, the expected damage from nematodes and/or fungi increases (1). Increasing soil pH, which has been effectively used to reduce the incidence and severity of ***Fusarium*** wilt of tomato, can also strongly influence the adverse interactive effect between nematode and disease (2). Polyethylene mulching has also been shown to alleviate damage by root-knot nematodes when no other active disease-causing organisms are present (5,6). Polyethylene mulching contributes greatly to the tomato plants increased tolerance to root-knot nematode infection by protecting plants from moisture stress, excessive leaching of nutrients, competition by weeds and the root pruning associated with cultivation.

Broad-spectrum soil fumigants have been used beneath polyethylene mulch in tomato production for over 2Ø years (8), and are now a common practice in soils repeatedly planted to tomato (7). The severity and recurring nature of multiple-pest problems in tomato production are difficult to predict and have, therefore, promoted the extensive use of broad spectrum fumigant nematicides. Methyl bromide/chloropicrin mixtures are the most frequently used fumigants in

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Fig. 1. Root gall symptoms induced by ***Meloidogyne incognita*** in tomato (*Lycopersicon* ***esculentum***). (Photograph courtesy A. J. Overman).

Fig. 2. Typical foliar symptoms of tomato caused by Fusarium wilt (***Fusarium oxysporum*** f. ***lycopersici***). (Photograph courtesy J. P. Jones)

soil pest management programs which include full-bed mulch, adjustment of soil reaction and use of host resistance to protect crops from ***Fusarium*** wilt race 2, ***Verticillium*** wilt, nematodes and weed infestations (2,7,9).

In 1978, over 60% of the entire tomato acreage in Florida was treated with a methyl bromide/chloropicrin fumigant (7). Methyl bromide and chloropicrin are currently registered in eight formulations of differing proportions for use in Florida tomato fields for control of soil borne insects, weeds, nematodes, and fungi. Two formulations, 98/2 and 67/33 are the most extensively used. With such an array of different formulations available, an element of complexity is introduced into grower fumigant selection decisions since each component material is known to have greater toxicity to specific pests (4).

In the case of different weeds, methyl bromide is the primary herbicidal agent for the methyl bromide-chloropicrin mixture, which has prompted the use of 98%-2% methyl bromide-chloropicrin formulation for more effective weed control (primarily nutsedge). Generally, nematodes are more sensitive to the multi-purpose fumigants than are many fungi, bacteria, weeds, or soil dwelling insects. However, some phytoparasitic nematodes may survive the fumigant treatment even at application rates sufficient to affect other more tolerant pests, such as ***Fusarium*** and ***Verticillium***.

The survivability of nematodes to fumigation is influenced by many factors. The presence of large, undecayed roots prior to treatment can shelter endoparasitic nematodes from lethal gases. Undecayed roots can be 8-16 times more resistant to fumigants than the pests or pathogens living in them, and this resistance increases markedly with root size (3). Inconsistent control of root-knot nematodes has occurred with chloropicrin when complete decay of infested roots was not achieved prior to fumigation. Conversely, excellent control of root-knot nematode infested roots has been obtained with methyl bromide which penetrates intact roots tissues more readily (4,11). In very dry soils, many nematodes which can survive in a dehydrated state can tolerate 10 times the lethal dose of active forms in moist soils (4).

Methyl bromide and chloropicrin are also used to reduce the incidence of soil borne fungal pathogens. In contrast to methyl bromide, chloropicrin is an excellent fungicide having a much wider spectrum of activity against many plant pathogenic fungi of economic importance (4,11). Toxicological studies relating the level of control of soil borne plant pathogens to increasing levels of chloropicrin in methyl bromide mixtures have not been performed or are not readily available. In some cases it has been shown that control of some fungal pathogens have been improved when chloropicrin was added to methyl bromide, apparently due to the additive toxicity of the two compounds together (4,11).

The comparative efficacy of the different rates and formulations of methyl bromide-chloropicrin are important considerations with respect to grower pest control decisions. Specific soil types, cultural and environmental conditions can promote the development of unique complexes of pests within a field. Developing guidelines for selection of fumigant nematicides based on a unique pest complex should allow a more customized and prescriptive approach to multiple pest control in Florida tomato.

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